

EMFAC Modeling Change Technical Memo

SUBJECT: Modification of Mileage Accrual Rates

LEAD: Hebbalalu Shamasundara

SUMMARY

The mileage accrual rate is an estimate of the miles per year traveled. The mileage accrual rates estimated in EMFAC are based on analyses of odometer data recorded in the Smog Check Program. These estimates are area, age, and vehicle class specific.

The EMFAC model maintains an internal relationship between mileage accrual rates, vehicle population, and vehicle miles of travel (VMT). Essentially, the VMT of a specific age and class of vehicles can be calculated as the product of the population and the corresponding mileage accrual rate.

This update will use data from the Bureau of Automotive Repair (BAR) Smog Check data base to determine the accrual rates for the following gasoline-powered vehicle classes:

DESCRIPTION	WEIGHT CLASS
PASSENGER CARS	ALL
LIGHT-DUTY TRUCKS	0- 3750
LIGHT-DUTY TRUCKS	3751- 5750
MEDIUM-DUTY TRUCKS	5751- 8500
LIGHT-HEAVY DUTY TRUCKS	8501-10000
LIGHT-HEAVY DUTY TRUCKS	10001-14000
MOTOR HOMES	ALL

Only gasoline-powered vehicles are included in the Smog Check program, so it will be assumed that diesel and electric-powered vehicles will have the same accrual rates as gasoline-powered vehicles of the same class.

The proposed change is estimated to reduce on-road vehicle exhaust emissions by seven percent for reactive organic gases (ROG), five percent for carbon monoxide (CO), two percent for oxides of nitrogen (NOx), and one percent for particulate matter (PM10), statewide in the year 2010. By 2020, the percent reductions estimated from the proposed change will be seven percent for HC, six percent for CO, and three percent for NOx and PM10, statewide.

AFFECTED SOURCE CODE

ACCR_*.f90

NEED FOR REVISION

The mileage accrual rates were last updated in 1999 as part of the EMFAC2000 release. Additionally, because of limits on data availability, only Smog Check data from calendar years 1991-1995 were used. This update utilizes more recent data (2001-2003).

METHODOLOGY

The mileage accrual rate is an estimate of the miles per year traveled. The mileage accrual rates are based on analyses of odometer data recorded in the Smog Check Program. These estimates are area, age, and vehicle class specific. The general approach is to capture corresponding odometer readings in calendar years 2001 and 2003, and determine the mileage accrued over that span of time (nominally two years).

The EMFAC model maintains an internal relationship between mileage accrual rates, vehicle population, and vehicle miles of travel (VMT). Essentially, the VMT of a specific age and class of vehicles can be calculated as the product of the population and the corresponding mileage accrual rate. The VMTs for most areas of the State are provided by either Councils of Government (COGs) or Metropolitan Planning Organizations (MPOs). In those instances where the vehicle population is known yet calculated and reported VMTs do not agree, the mileage accrual rates are adjusted until the target VMTs are achieved.

For this analysis, staff extracted approximately 10 million vehicle records from the BAR 2001 database and were able to locate 6 million matching vehicles in the BAR 2003 database. The matched data were then sorted by county, vehicle class, and model year (MY).

Rollover

Vehicles built before 1990 often have only 5 digits available for the odometer. After 99,999 miles, the odometer returns to 00,000 miles. This is referred to as odometer rollover. Without adjusting for this phenomenon, the average odometer would be biased low. Staff can sense that rollovers have occurred when the odometer reading of the first test year is greater than in subsequent test years. These rollovers were converted by establishing a cutoff of 100,000 as the maximum reasonable difference allowed between consecutive test year odometer readings. For those vehicles that do demonstrate a rollover condition, the odometer difference was determined by the following equation:

$$\text{ODODIFF} = (100,000 - \text{ODO2001}) + \text{ODO2003}$$

Otherwise, the odometer difference was calculated by a straight subtraction:

$$\text{ODODIFF} = \text{ODO2003} - \text{ODO2001}$$

where:

ODO2003 = odometer reading for 2003

ODO2001 = odometer reading for 2001

ODODIFF = difference between odometer readings

Calculation of Accrual Rate

The data were first sorted by vehicle identification number (VIN), then conditions were set to screen out erroneous records such as zero odometer readings, zero odometer differences, and zero age values. The age of the vehicle is defined as the difference between the second test date of the vehicle and the model year of the vehicle. In this way, the age of the vehicle at the time of the second test is determined. A zero age value therefore would be indicative of an erroneous input during testing. The miles traveled between smog checks were then determined and converted to average miles traveled per year using the following equations.

Duration = testdate2003 – testdate2001 (in days)

Miles traveled per year = $365.25 * \text{ODODIFF} / \text{Duration}$.

Results

Staff regressed Mean Accrual Rate as a function of Age. The resulting equations and coefficients are given in Table 1.

For some counties, insufficient data existed to perform adequate regression analyses. For such areas, nearby county equations were utilized. Table 2 gives the county substitution list. For truck categories T3-T5 and Motor Homes, there were only sufficient data for establishing statewide average accrual rates.

Table 1: Mileage Accrual Rates by Area

ACCR = A*ln(Age)+B

AREA	COUNTY	COUNTY ABBNTYCODE	AB	REG Eq. For PCs		REG Eq. For T12s		REG Eq. For T3s		REG Eq. For T4s		REG Eq. For T5s		REG Eq. For Mhs		
				B	A	B	A	B	A	B	A	B	A	B	A	
1	ALPINE	ALP	2	GBV	23857	-5587.5739	20153	-3757.7532	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
2	INYO	INY	14	GBV	20999	-4113.6866	21057	-3797.8048	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
3	MONO	MON	26	GBV	23857	-5587.5739	20153	-3757.7532	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
4	LAKE	LAK	17	LC	20660	-4538.2302	24442	-5756.7041	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
5	EL DORADO	ELD	9	LT	23857	-5587.5739	20153	-3757.7532	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
6	PLACER	PLA	31	LT	18378	-3578.1710	20175	-4062.3192	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
7	AMADOR	AMA	3	MC	19236	-3963.2123	20222	-4142.2297	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
8	CALAVERAS	CAL	5	MC	20889	-4565.3957	21272	-4473.1766	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
9	EL DORADO	ELD	31	MC	23857	-5587.5739	20153	-3757.7532	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
10	MARIPOSA	MPA	22	MC	21047	-4299.1185	21690	-4545.2619	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
11	NEVADA	NEV	29	MC	17589	-3196.2661	21625	-4651.9562	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
12	PLACER	PLA	31	MC	18378	-3578.1710	20175	-4062.3192	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
13	PLUMAS	PLU	32	MC	17589	-3196.2661	21625	-4651.9562	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
14	SIERRA	SIE	46	MC	17589	-3196.2661	21625	-4651.9562	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
15	TUOLUMNE	TUO	55	MC	20889	-4565.3957	21272	-4473.1766	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
16	MONTEREY	MON	27	NCC	18217	-3423.4017	16873	-2351.7561	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
17	SAN BENITO	SBT	35	NCC	19384	-3707.0678	23748	-4936.9827	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
18	SANTA CRUZ	SCR	44	NCC	18097	-3496.6127	17823	-3093.6232	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
19	DEL NORTE	DN	8	NC	20886	-4183.9866	20655	-4017.9952	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
20	HUMBOLDT	HUM	12	NC	20886	-4183.9866	20655	-4017.9952	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
21	MENDOCIN	MEN	23	NC	20886	-4183.9866	20655	-4017.9952	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
22	SONOMA	SON	49	NC	16240	-2774.3246	17709	-3027.4853	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
23	TRINITY	TRI	53	NC	20886	-4183.9866	20655	-4017.9952	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
24	LASSEN	LAS	18	NEP	19730	-4111.5478	20099	-4066.0348	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
25	MODOC	MOD	25	NEP	19730	-4111.5478	20099	-4066.0348	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
26	SISKIYOU	SIS	47	NEP	19730	-4111.5478	20099	-4066.0348	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
27	BUTTE	BUT	4	SV	17708	-3234.9115	19628	-3660.0493	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
28	COLUSA	COL	6	SV	19146	-3607.2561	19175	-3633.8893	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
29	GLENN	GLE	11	SV	25574	-6253.9375	25680	-6136.5578	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
30	PLACER	PLA	31	SV	18378	-3578.1710	20175	-4062.3192	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
31	SACRAMENT	SAC	34	SV	19236	-3963.2123	20222	-4142.2297	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
32	SHASTA	SHA	45	SV	19730	-4111.5478	20099	-4066.0348	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
33	SOLANO	SOL	48	SV	19973	-4095.6720	20978	-4281.2114	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
34	SUTTER	SUT	51	SV	17674	-3077.4870	19338	-4296.1812	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
35	TEHAMA	TEH	52	SV	19438	-3897.1192	21350	-4520.9244	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
36	YOLO	YOL	57	SV	19146	-3607.2561	19175	-3633.8893	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
37	YUBA	YUB	58	SV	21155	-4259.9000	22697	-4798.3009	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
38	SAN DIEGO	SD	37	SD	18435	-3610.2934	19269	-3593.4936	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
39	ALAMEDA	ALA	1	SF	16733	-2838.2411	17697	-2785.4432	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
40	CONTRA CO	CC	7	SF	17443	-3139.7194	17511	-2655.4673	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
41	MARIN	MAR	21	SF	15455	-2849.4007	17179	-2988.9096	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
42	NAPA	NAP	28	SF	16552	-2718.7270	14166	-1302.6845	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
43	SAN FRANCIS	SF	38	SF	16586	-3132.8673	16522	-2809.6827	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
44	SAN MATEO	SM	41	SF	15843	-2566.1965	15188	-1551.8456	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
45	SANTA CLAR	SCL	43	SF	16531	-2904.2370	16850	-2575.7987	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
46	SOLANO	SOL	48	SF	19973	-4095.6720	20978	-4281.2114	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
47	SONOMA	SON	49	SF	16240	-2774.3246	17709	-3027.4853	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
48	FRESNO	FRE	10	SJV	20437	-4140.5216	20337	-3862.2833	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
49	KERN	KER	15	SJV	18931	-3740.7885	19975	-3922.4174	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
50	KINGS	KIN	16	SJV	21221	-4333.9810	18946	-3135.5157	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
51	MADERA	MAD	20	SJV	19207	-3684.7658	23851	-5337.1010	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
52	MERCED	MER	24	SJV	21047	-4299.1185	21690	-4545.2619	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
53	SAN JOAQUIN	SJV	39	SJV	20637	-4245.8115	20952	-4075.6750	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
54	STANISLAUS	STA	50	SJV	20889	-4565.3957	21272	-4473.1766	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
55	TULARE	TUL	54	SJV	19194	-3473.3921	19325	-3225.2960	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
56	SAN LUIS OESLO	SLO	40	SCC	18376	-3252.2969	17901	-2744.9581	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
57	SANTA BARESB	SB	42	SCC	18052	-3392.7055	15824	-2083.4114	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
58	VENTURA	VEN	56	SCC	19610	-4152.1572	19030	-3442.9417	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
59	LOS ANGELES	LA	19	SC	18360	-3447.5471	17715	-2605.8978	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
60	ORANGE	ORA	30	SC	18944	-3954.1572	19853	-3822.9323	19513	-3451.4256	19957	-3580.6494	20023	-3747.9552	5218	-632.5345
61	RIVERSIDE	RIV														

Figures 1 and 2 illustrate how well the accrual rate equations fit the data.

Figure 1

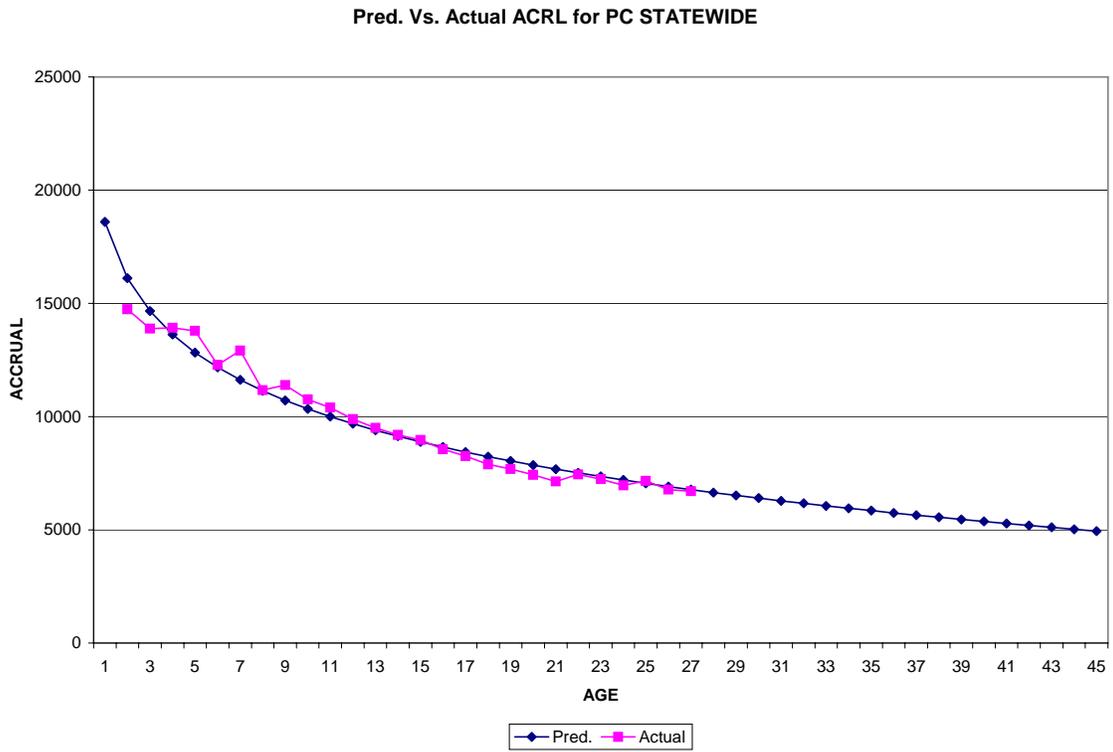
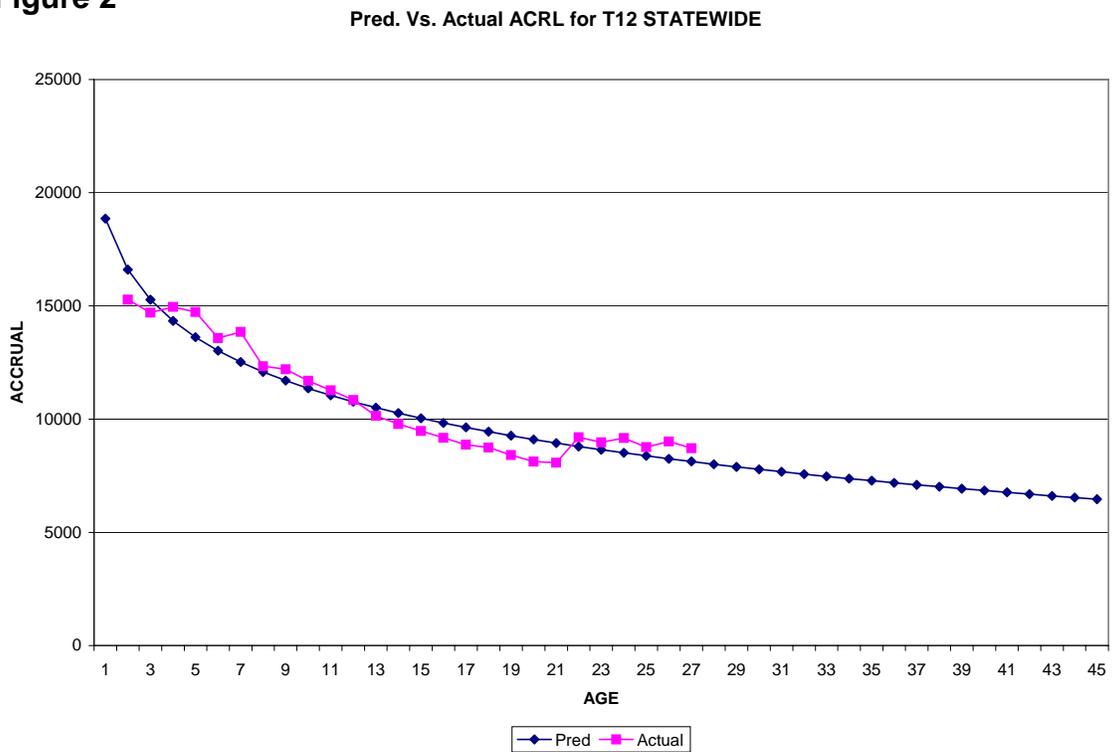


Figure 2



EMISSIONS IMPACT

The emissions impacts were estimated by substituting the new mileage accrual rates into the ACCR_*.f90 files in the EMFAC model. The impact on passenger car emissions and the on-road inventory as a whole is displayed in the following tables.

TABLES HERE

FUTURE WORK

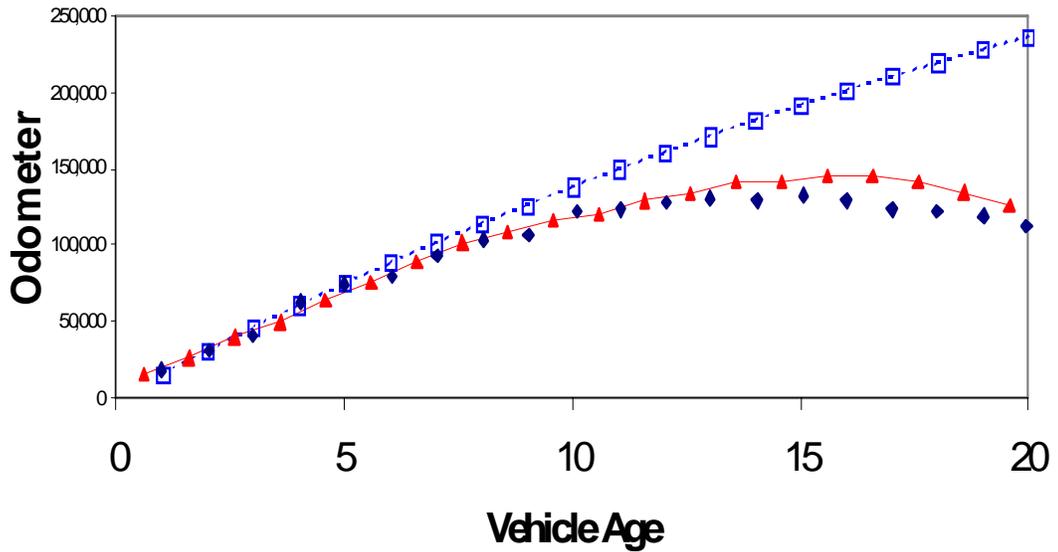
During the AB1493 (Greenhouse Gas) regulatory process, Sierra Research raised an issue regarding how EMFAC determines the odometer value as vehicles age. EMFAC calculates the odometer at a given age as the sum of all the previous years' accrual rates. As noted by Sierra Research, this practice tends to be inflationary in that the odometer estimates would not properly account for vehicles that accrued high mileage and retired early from the fleet. In reality, these vehicles would have no influence on the mean odometer of older vehicles.

In Sierra Research's analysis of this issue, their estimates of cumulative mileage are in reasonable agreement with those of EMFAC for the first ten years of vehicle usage (Figure 3).

Although staff acknowledge that Sierra's claim is legitimate, it is important to note that the impact of this issue is limited to the assumption of emissions deterioration, and only for those vehicles beyond ten years old. Therefore, staff believes that the impact of this issue on the overall inventory is small, but will investigate correcting the problem in subsequent revisions to the model.

Figure 3

Vehicle Age Vs. Average Odometer Passenger Cars



---□--- CARB additive methodology —▲— Smog Check data ◆ Roadside Pullover

Source: Frank Di Genova, Sierra Research, CRC 15th Workshop in San Diego, April 4-6, 2005